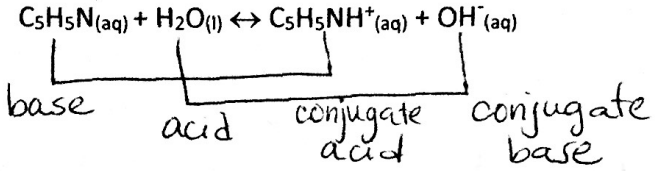
Chemistry 129 Quiz # 8

Name: Key

Solve the following problems:

1. (4pts.) For the following reaction, identify the Brønsted-Lowry acid, Brønsted-Lowry base, conjugate acid, conjugate base:



2. (4pts.) What is the concentration of a solution of $Sr(OH)_2$ with pH=11.48?

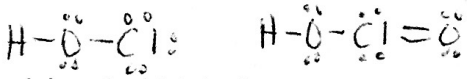
$pOH = 14.00 - 11.48 = 2.52$

$[OH^-] = 10^{-2.52} = 3.0 \times 10^{-3} M$

$[Sr(OH)_2] = \frac{3.0 \times 10^{-3} M}{2} = 1.5 \times 10^{-3} M$

3. (7 pts.)
   a. The pKa of chlorous acid, $HClO_2$, is 1.96. Is the pKa of hypochlorous acid, HClO, larger or smaller? Explain.

HClO has a larger pKa (pKa = 7.53) than $HClO_2$.
The stronger an acid is, the smaller its pKa will be.
HClO is weaker than $HClO_2$. $HClO_2$ has an additional oxygen atom (highly electronegative) which helps draw electron density away from Cl which in turn draws electron density away from O-H bond. Weaker bond, H comes off more easily.



   b. What are the conjugate bases of $HClO_2$ and HClO (give chemical formula) and which is the stronger one? Why?

Conjugate base of $HClO_2$: ClO_2^-
Conjugate base of HClO: ClO^- ⟸ stronger base

HClO is the weaker acid so its conjugate base will be stronger than the conjugate base of $HClO_2$.

4. (10 pts) Consider a 0.175M $HClO_2$ solution,
   a. Write the chemical equation for the acid-dissociation of $HClO_2$ in water.
   b. Determine **[ClO_2^-], [H_3O^+], [$HClO_2$]** at equilibrium and the **pH** of a ~~0.100M solution of NH_4NO_3~~. The pK_a of $HClO_2$ is 1.96.
   c. What's the **percent dissociation** of $HClO_2$ in the solution?

(a) $HClO_{2\,(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + ClO_2^-{}_{(aq)}$

(b) $K_a = \frac{[H_3O^+][ClO_2^-]}{[HClO_2]} = 1.1 \times 10^{-2}$

$K_a = 10^{-pK_a} = 1.1 \times 10^{-2}$

$\frac{[HA]}{K_a} = \frac{0.175\,M}{1.1 \times 10^{-2}} = 16 < 400$

use quadratic formula

$\frac{(x)(x)}{0.175 - x} = 1.1 \times 10^{-2}$

$x^2 = (1.1 \times 10^{-2})(0.175 - x)$

$x^2 = 1.9 \times 10^{-3} - 1.1 \times 10^{-2} x$

$x^2 + 1.1 \times 10^{-2} x - 1.9 \times 10^{-3} = 0$

$x = \frac{-(1.1 \times 10^{-2}) \pm \sqrt{(1.1 \times 10^{-2})^2 - (4)(1)(-1.9 \times 10^{-3})}}{2(1)}$

	$[HClO_2]$	$[H_3O^+]$	$[ClO_2^-]$
I	0.175	0	0
C	$-x$	$+x$	$+x$
E	$0.175 - x$	x	x

$x = -0.049\,M$ $\quad x = 0.038\,M = [H_3O^+]$

$[H_3O^+] = 0.038\,M$

$[ClO_2^-] = 0.038\,M$

$[HClO_2] = 0.175\,M - 0.038\,M$

$= 0.137\,M$

$pH = -\log(0.038) = 1.42$

(c) % ionization $= \frac{[H_3O^+]}{[HA]} \times 100$

$= \frac{(0.038\,M)}{0.175\,M} \times 100 = 22\%$